



To Our Valued Customers,

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YASUNAGA CORPORATION

Akitoshi Yasunaga, President

(TSE 1<sup>st</sup> Code : 7271)

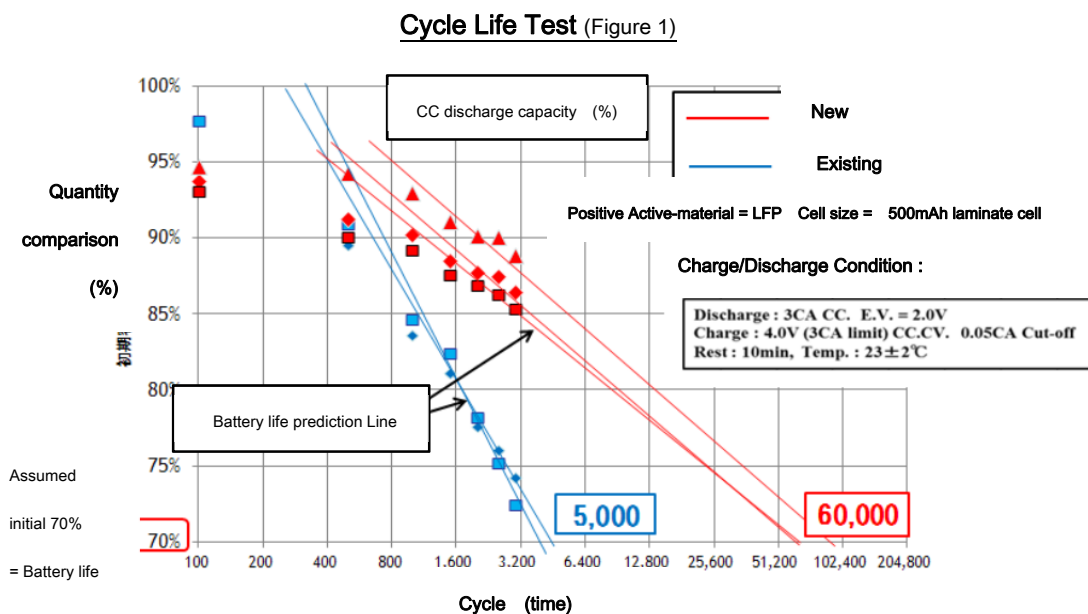
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### Introduction of our New Technology Development Into the Lithium Ion Battery (LIB) Production

We developed our original new technology for LIB positive electrode to extend battery life by more than 12 times (in-house comparisons) compared to the existing battery. (Patent pending)

#### 1. Summary of our revolutionary achievement

We conducted Endurance tests by using in-house prototype cell. We used the life prediction line (Figure 1) obtained from the up to 3,000 cycles test, with our assumption of the end of battery life set at 70% from the original capacity, our newly developed product is expected to achieve well over 60,000 cycles, compared to 5,000 cycles of the existing one, which is more than 12 times battery life improvement.



## 2. Key points of our development

### (1) Achieving Long life by peeling restraining of active material

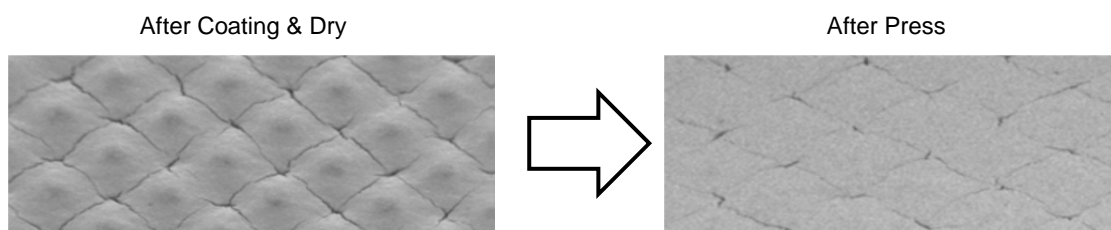
Until now, active material and current collector are bounded (surface bond) only by the binder adhesion. Consequently, gradual peeling of active material, caused by the bending stress during cell production and/or the expansion/contraction of active material during charging/dischARGE, has been causing the great effect of battery life.

However, with Yasunaga's own creative ideas, we succeeded in peeling restraining of active material by expanding electrode surface area along with anchor effect of active material. Those creative ideas are

- 1) unique and special process for current collector utilizing [Micro Forming Technology] and
- 2) [Fine cracks with regular geometric pattern on electrode surface] formed by the electrode manufacturing technology, which is completely different from existing technology

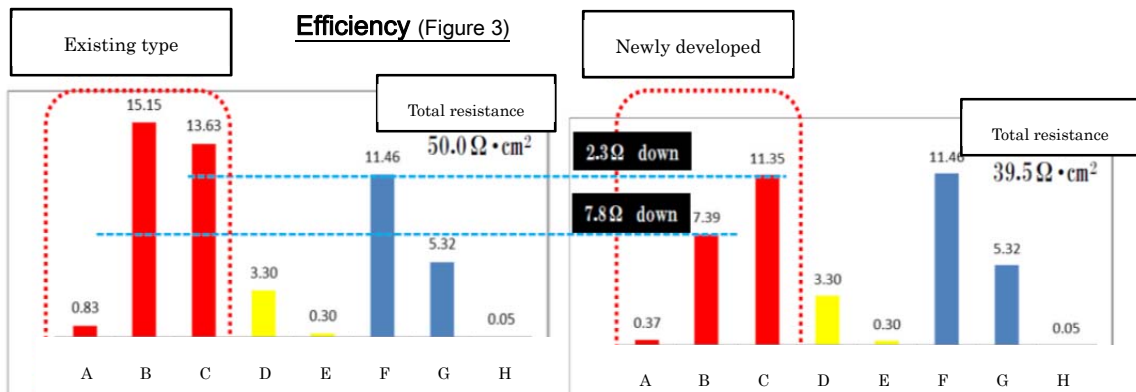
Also "Plated through hole (PTH)" formed during the process into the current collector has synergistic effect in extending battery life, due to the improvement of peeling durability by adhesion between active materials from both sides, and to the prevention of unevenly distributed electrolyte normally caused by transferring electrolyte.

### **Appearance of Positive electrode (Figure 2)**



### (2) High-speed charge/discharge by reducing interfacial resistance between current collector and active material

"[Effect of reducing interfacial resistance] between current collector and active material", resulting from the above adhesive improvement, has been verified by a third-party research institute as follow. It should be noted, the performance improvement of the high-speed charge/discharge, resulting from the effect of reducing interfacial resistance, is especially effective when materials like LFP and LTO are used due to its low conductivity.



A Positive (P) electronic resistance B P-react resistance C P- diffusion resistance D Separator Ion resistance  
 E Separator Ion diffusion resistance F Negative (N) diffusion resistance G N-react resistance H N-electronic resistance

Target item : B & C

Normalized value : Ω/cm<sup>2</sup>

### Cell Composition (Figure 4)

Cell Composition	Positive active material	LFP
	Negative active material	Natural graphite
	Separator	Non-woven glass (120um)
	Electrolyte	KRI standard
		1.0M LiPF <sub>6</sub> / 3EC/7MEC
	Reference electrode	Lithium Metal
	Electrode size	14mm x 20mm

### 3. Promising effect/outcome

Following promising effect/outcome can be expected by the excellent characteristics mentioned on the above.

#### (1) Effect of Long-life

- ① Popularization of stationary power for household use because of long-term maintenance free.
  - ② Reducing running cost for lease items (ex. Welfare-vehicle, e-scooter, etc.)
  - ③ Installation into sealed devices, which are placed at the hard to reach areas.
- Contributing to the reduction of environmental burdens and energy cost.

#### (2) Effect of high-speed charge/discharge

- ① Improving operating efficiency for EV car-sharing / EV taxi
- ② Miniaturization of the devices which require high output power.
- ③ Enabling of adding high output functions to the mobile devices.

Contributing to higher user satisfaction and enhancing "Smart Society".

4. Mission for our original new technology

Our Mission, preparing for the future, is to aggressively pursue new technologies and products, which will lead to the solution of the various issues stemming from the global resources, energy and environment, by promoting applications utilizing our original new technology for Lithium Ion Battery (LIB).

< Contact for this Revolutionary Technology >

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